5G-Enabled Smart Ports: Experiences and Prospects

Institute of Communication & Computer Systems

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Workshop
5G & GOVTECH
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About Us

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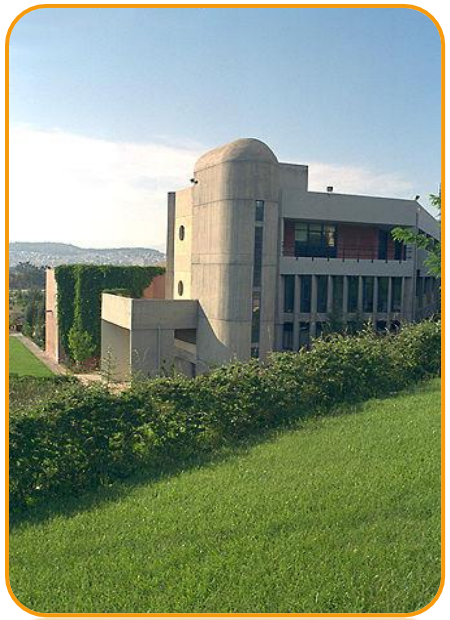
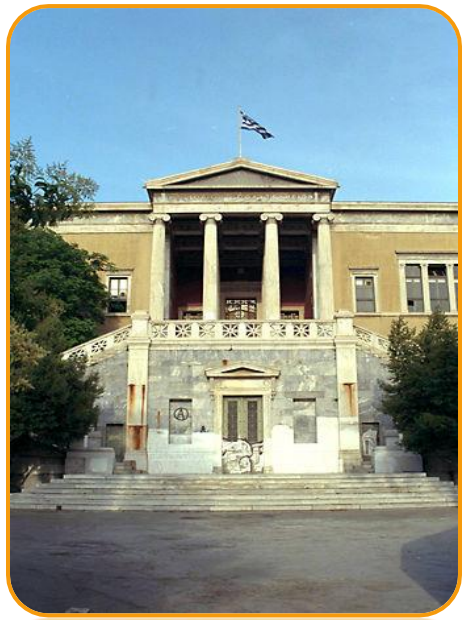


ICCS

ICCS is the oldest and largest academic Research Institute in Greece. Being the research branch of the School of Electrical and Computer Engineering of the National Technical University of Athens (NTUA), ICCS conducts interdisciplinary cutting edge research and R&D activities in in relevant scientific fields, supports doctoral theses, undertakes innovative & development activities and provides scientific services to private & public bodies in Greece and abroad.



RESEARCH IMPACT

With a mission to promote basic and applied research, advance digitalisation and boost innovation, ICCS today stands among the top 3 Research Institutions in Greece. It is also ranked among the top 20 European Institutes in terms of research funding in its fields. Committed to the highest standards of academic research, the Institute maintains well organised facilities based in Athens and a reputation as a top-level research institution worldwide.

About Us

R&D Projects

At ICCS, we continuously advance our expertise and scientific knowledge through the participation of our research teams in National and European R&D projects in various scientific fields.

4498 +

Researchers & Scientific Personnel

Excellent research staff lies at the basis of ICCS's success. More than 800 highly qualified researchers, scientists and faculty members are the main pilar of the Center's successful performance.

800+

Innovation

ICCS actively supports the creation of startups and participates in successful spinoffs such as 'The first Greek Energy Competence Center'.

06

Scholarships & Excellence

With an aim to promote scientific excellence, ICCS every year provides scholarships to Phd students and supports a number of Educational activities.

1650

About Us

150 People

58 / 110 Ongoing/Finished Projects

191 Partners

Full Research Member

National Technical University of Athens

Institute of Communication & Computer Systems

Research areas

- Cooperative Connected & Automated Mobility
- Smart Mobility Applied Systems
- Intelligent Networks & Services
- Logistics & Maritime
- Industry 5.0 & Smart Manufacturing
- Health Technologies
- Earth Observation & Environmental Monitoring
- Crisis Management & Secure Societies
- Circular Economy & Tracing
- XR Culture & Society

SMART PORTS

WHAT IS A SMART PORT?

*"A smart port equips the workforce with relevant skills and **technology** to solve the unique internal and external challenges of the organisation, and to facilitate the efficient movement of goods, delivery of services and smooth flow of information."*

Wikipedia, https://en.wikipedia.org/wiki/Smart_port

"…a connected port that protects the environment and mobilizes **innovative technologies** for business process and information flow management."

Rajabi, A., et al., "Towards smart port: An application of AIS data," In IEEE HPCC/SmartCity/DSS, 2018

"… a modern and technologically advanced port that leverages **innovative technologies** and data-driven solutions to enhance its operational efficiency, safety, and sustainability."

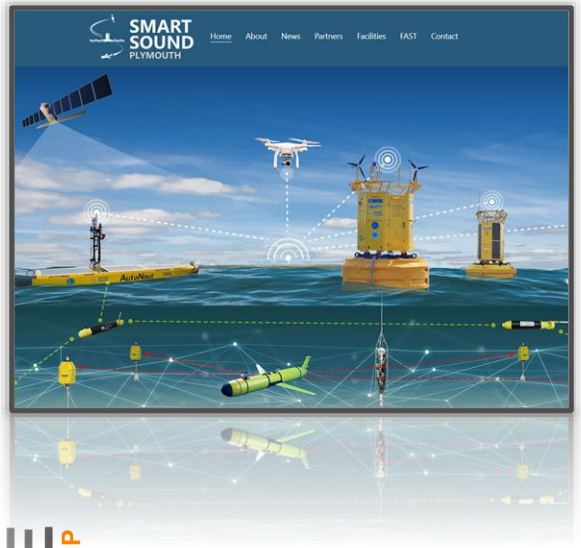
PORT Technology International, https://www.porttechnology.org/

"…a **connected, automated port** designed to meet stakeholder demand."

Molavi, A., et al.,"A framework for building a smart port and smart port index. International Journal of Sustainable Transportation, 14(9), 686–700, 2020

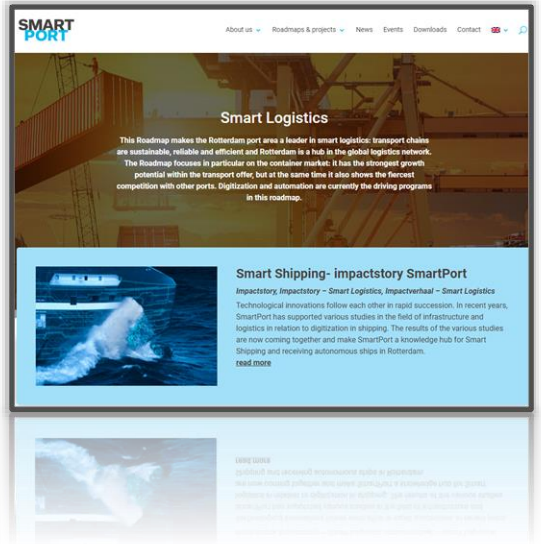
SMART PORT EXAMPLES

Smart Sound Plymouth (UK)



Port Oulu (FI)

Smart Port Rotterdam (NL)



Port of Hamburg (DE)

SMART PORT APPLICATIONS

Port operations: offshore / onshore
- Vessel / crane / truck monitoring, traffic management

Remote control
- Vessels / cranes / trucks

Safety
- Workers, goods

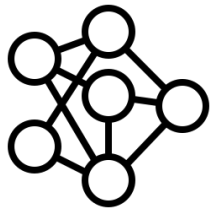
End-to-end logistics
- Vessel-port-truck-logistics hub

Connectivity services
- Seamless roaming

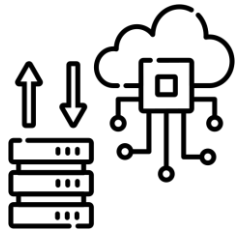
Digital Twins
- Holistic environment

Source: Nexus Integra

ENABLING TECHNOLOGIES

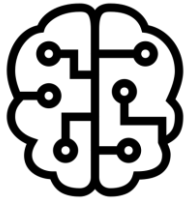


Connectivity
- **5G System**
- Satellite/NTN
- …

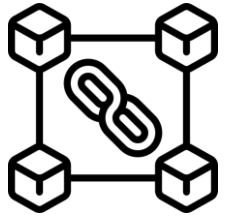


Cloud / Edge Computing
- Cloud native technologies
- Variable HW incl. AI support

IoT Technology
- Sensing/actuation
- Embedded computing

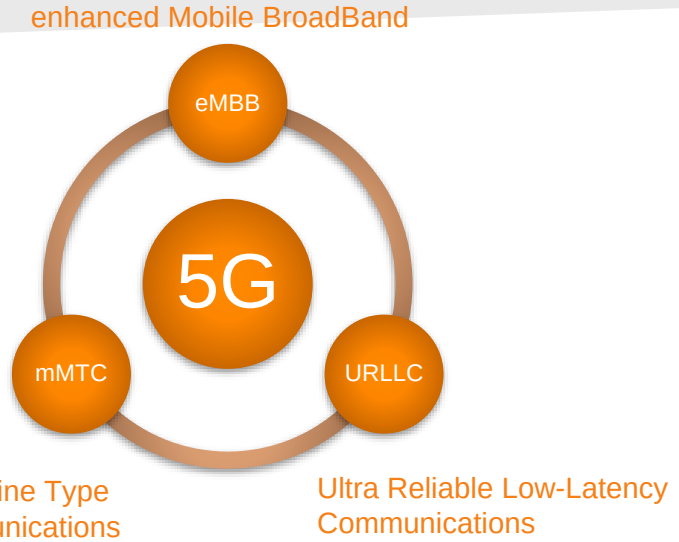


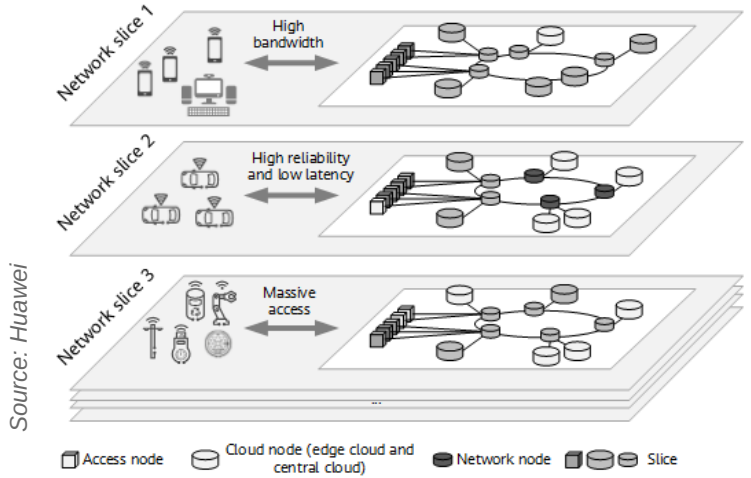
AI / ML
- Video analytics,…
- MLOps



Blockchain
- Smart contracts

THE ROLE OF 5G





Enhanced performance

- Data rates (eMBB)
- Latency & reliability (URLLC)
- Device density (mMTC)

Service differentiation

- Network Slicing
- Cloud Native

Vertical – Network Interaction

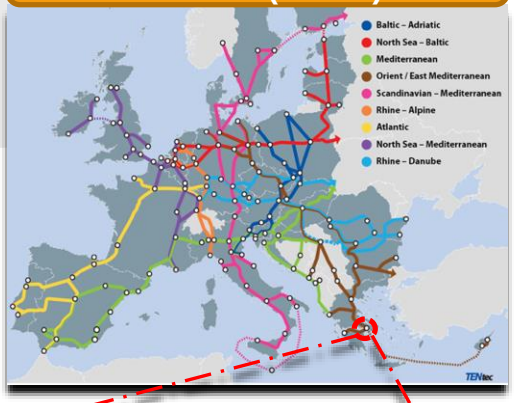
- Network Exposure Function (NEF)
  - Application Function (AF)
- CAMARA GSMA/LF

Our Experience

THE 5GLOGINNOV ATHENS LIVING LAB

Partners		Role
ICCS	Institute of communication and computer systems (**ICCS**)	Living Lab Coordinator (5G-IoT, NFV-MANO, AI/ML)
vodafone	Vodafone (Innovus)	Mobile Network Operator
PCT	Piraeus Container Terminal (**PCT**)	Living Lab

Trans-European Transport Network (TEN-T)



5G & AI-enabled Use Cases

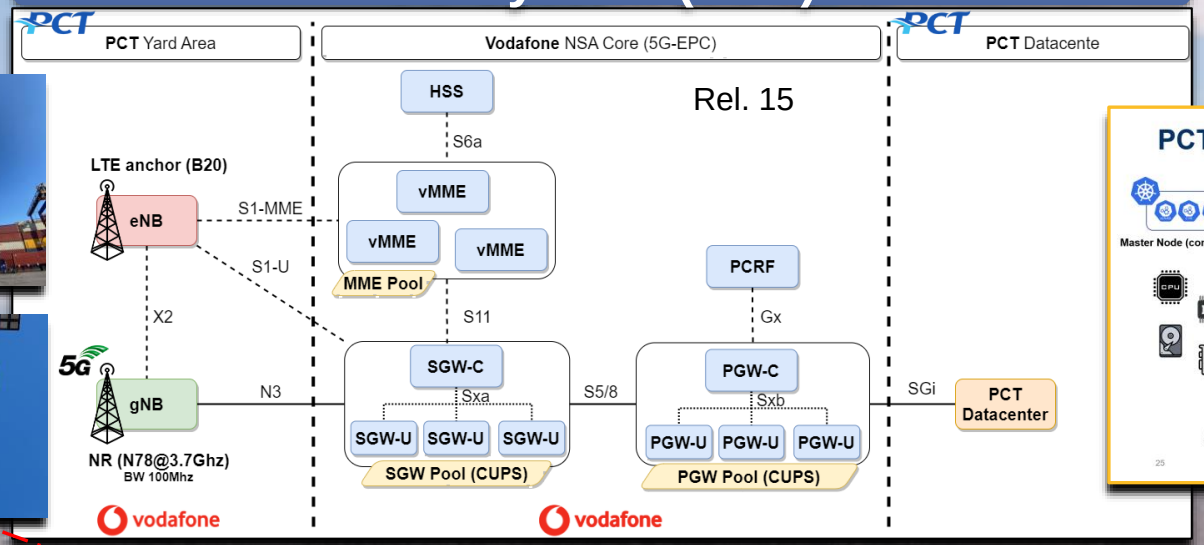
- **Surveillance and monitoring**
- **Container seal detection**
- **Collision warning**

PRIVATE 5G NETWORK AND 5G-IOT PLATFORM

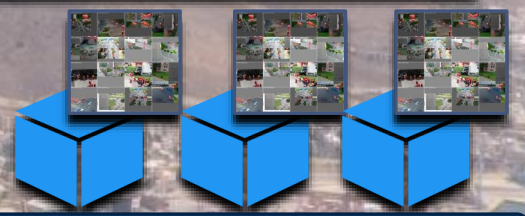
Far-edge

5G-IoT Nodes

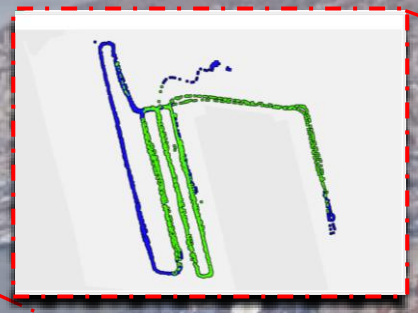
5G System (5GS)



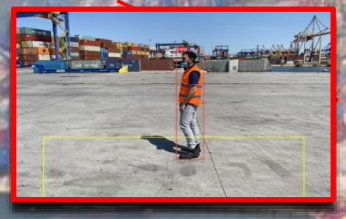
Cloud



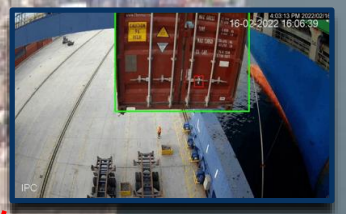
AI-enabling HW (GPUs)



Trials Area



Truck



Quay Side Crane

Port Infrastructure

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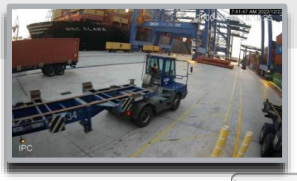
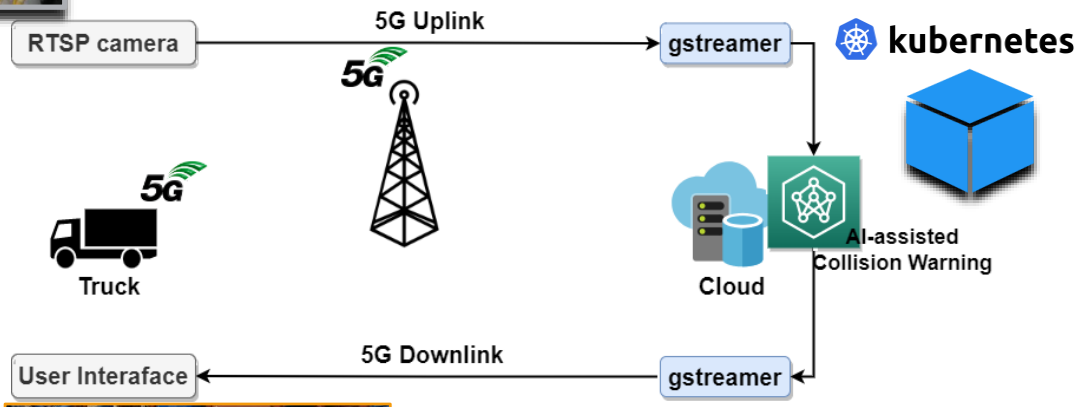
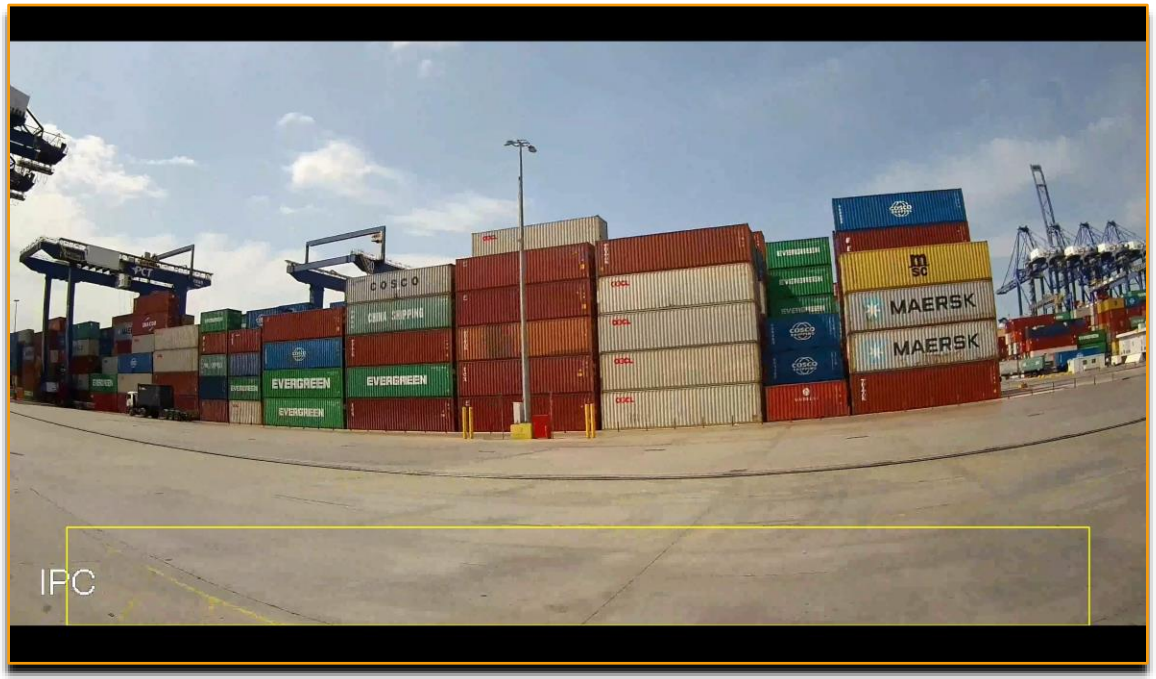
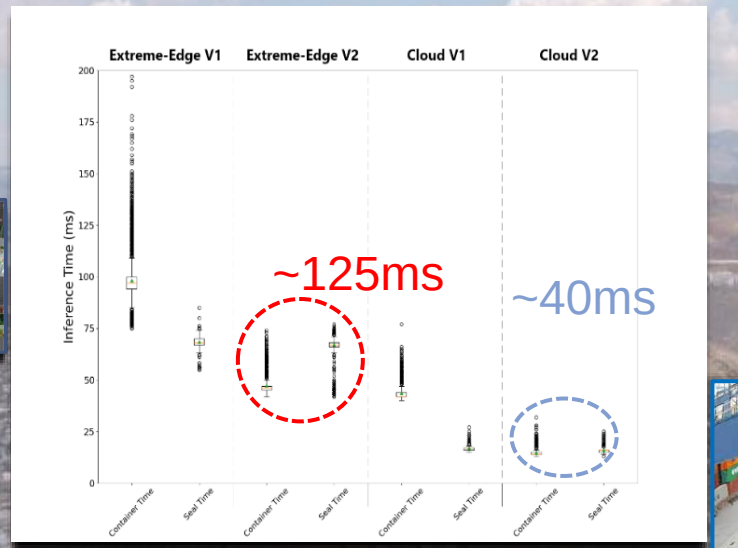
COLLISION WARNING

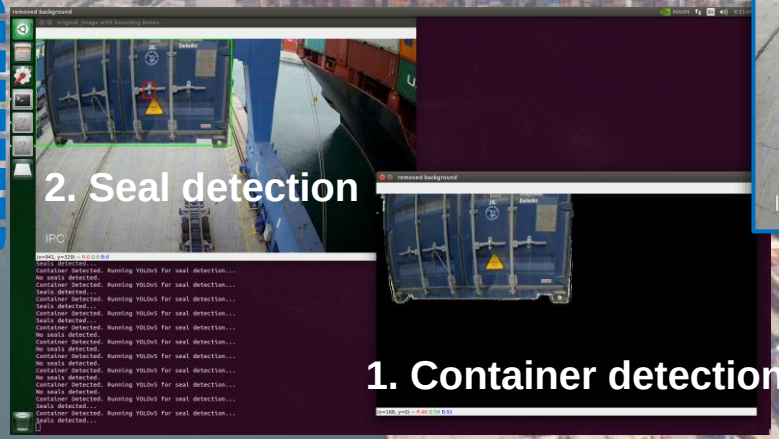






CONTAINER SEAL DETECTION





Training Set: 50K -> 500K images
Validation: 30 hours

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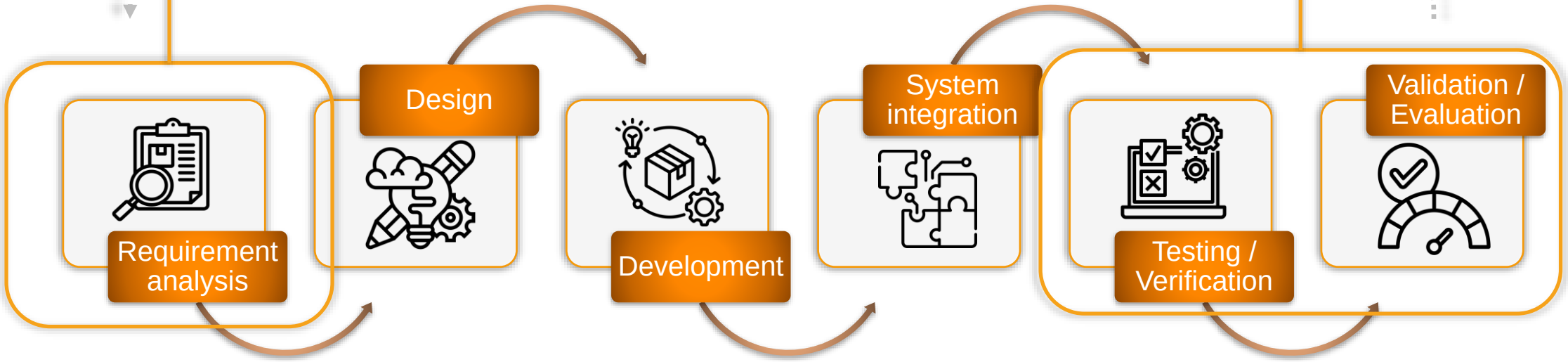
LESSONS LEARNED

User requirements ↔ technology capabilities
What is needed ↔ what is possible

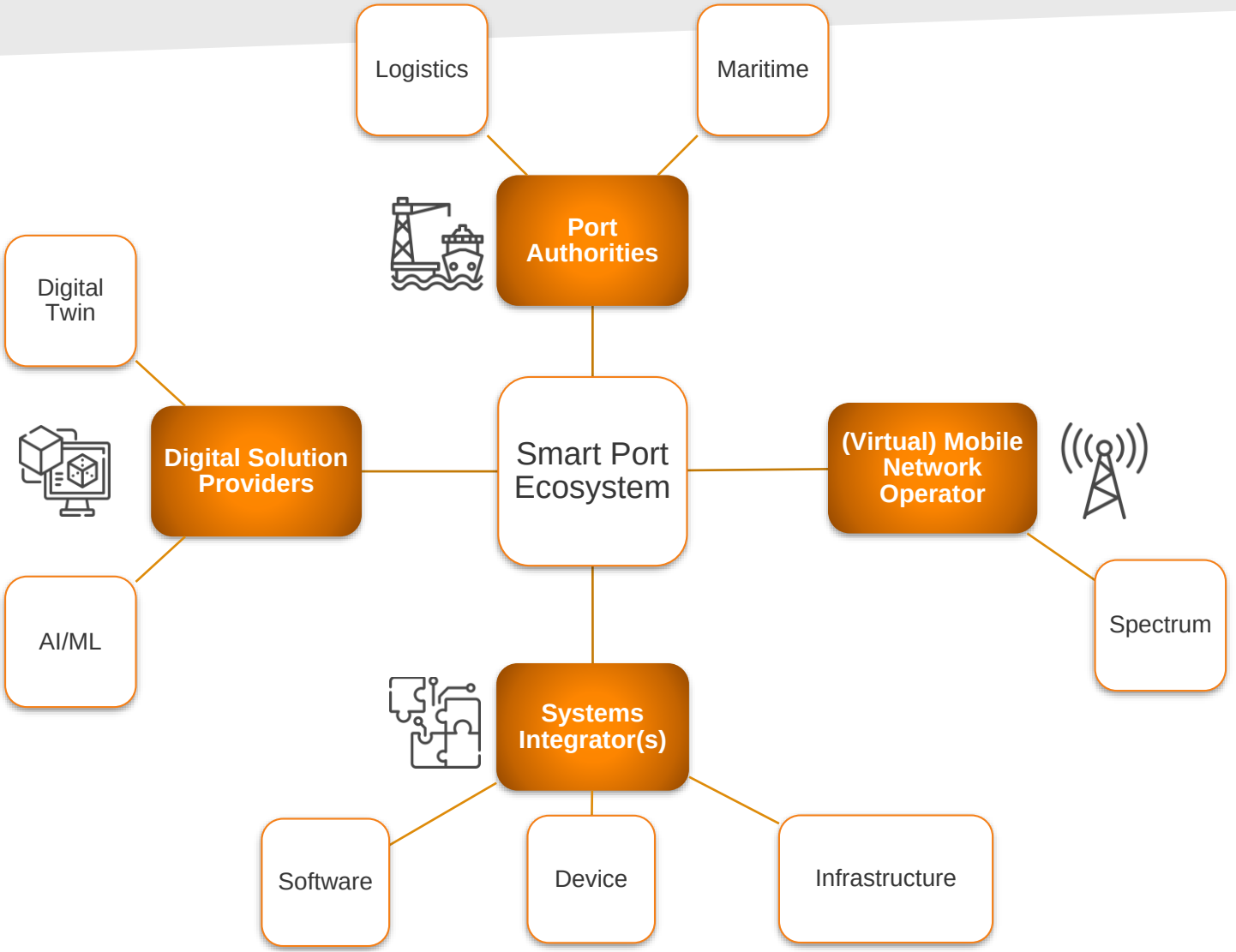
Operational environment
Often harsh / unpredictable conditions



Complex, multi-technology environment
Device – Network – Cloud – Application | APIs

TOWARDS TESTBEDS / SANDBOXES

BUILDING THE ECOSYSTEM …



...AND TAKING THE FIRST STEPS

Collaboration environment

co-creation processes

- Capturing operational needs
- Grasping novel technology capabilities
- Bridging technology domains
- Extensive experimentation

- Address market needs
- Provide end-to-end solutions
- Ensure maturity / robustness

THANK YOU!

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